



## Threatened and Endangered Vertebrate Species Richness

These EnviroAtlas national maps display the number of federally threatened and endangered vertebrate species with potential habitat within each 12-digit hydrologic unit (HUC) in the conterminous United States. These data are based on habitat models, not wildlife counts.

### Why are threatened and endangered vertebrate species important?

In 1973, “Congress, on behalf of the American people, passed the [Endangered Species Act \(ESA\)](#) to prevent extinctions facing many species of fish, wildlife, and plants.”<sup>1,2</sup> The ESA conserves threatened and endangered species and the ecosystems on which they depend as part of America’s heritage. Species are listed as either endangered or threatened depending on the species’ status and the degree of threat. Endangered species are those species that are in danger of extinction throughout all or much of their range; threatened species are likely to become endangered in the foreseeable future. The ESA defines species broadly to include subspecies and distinct populations to help conserve genetic diversity.<sup>2</sup> Total expenditures by Federal agencies on endangered or threatened species was \$1.3 billion for fiscal year 2014, while state agencies spent \$69 million.<sup>3</sup>

Species richness is one measure of [biodiversity](#) that can represent the relative conservation value of a particular area. Many scientists believe that biodiversity, because it represents all forms of life on earth, provides or supports the core benefits that humans derive from their environment to sustain human society, economy, health, and well-being. Managing for biodiversity is one way to balance competing demands for ecosystem services.<sup>4</sup>

Each species plays an important role within its [ecosystem](#). Ecosystems are highly interconnected—each species depends on others for some aspect of its survival to provide food, habitat, decomposition, pollination, or control of pest species. The loss of vulnerable species may negatively affect the function of ecosystems and the benefits they provide. The removal of even one species from an ecosystem can create a [trophic cascade](#) that can affect the entire [food chain](#). For example, grazers and browsers directly modify the species composition, diversity, and condition of grassland and forest habitats. Top predators, by regulating herbivore numbers, indirectly influence habitat condition and diversity by reducing grazing pressure on plant production.<sup>5</sup>



Photo: Florida panther, C. Bransilver, USFWS

Characteristics of biodiversity are valued in a variety of ways and thus they are important to include in any assessment that seeks to identify and quantify the value of ecosystems to humans. Some biodiversity metrics clearly reflect ecosystem services and their contribution to our quality of life and economy (e.g., abundance and diversity of game species), whereas others reflect indirect relationships to services (e.g., relevance of species diversity to ecosystem resilience, cultural value, and aesthetic amenities). In addition to their ecosystem roles, threatened and endangered vertebrate species are important to many people simply for their presence within environments. Many of these species provide recreational, cultural, or aesthetic value and may contribute to an area’s ability to attract tourism and tourism-related jobs.

### How can I use this information?

Three EnviroAtlas maps, Mean, Maximum, and Normalized Index of Biodiversity (NIB), illustrate Threatened and Endangered Vertebrate Species Richness for each 12-digit HUC within the conterminous United States.<sup>6</sup> Used together or independently, these maps can help identify areas of potentially low or high threatened and endangered vertebrate species richness to help inform decisions about resource restoration, use, and conservation. Mean richness is a commonly used and understood value for comparison. NIB provides an index to compare a metric with other metrics across multiple project scales simultaneously. Maximum richness identifies areas that are species rich but may not occupy large areas (e.g. linear riparian areas).

These maps can be used in conjunction with other EnviroAtlas maps such as ecoregions, the U.S. Geological Survey (USGS) protected areas database ([PAD-US](#)), or the USGS Gap Analysis Project ([GAP](#)) ecological systems to identify areas with high ecological or recreational value for conservation, recreation, or restoration planning. After learning the threatened and endangered species richness values for a particular 12-digit HUC, users can investigate an area more intensively by using individual species models available from the GAP project.

## How were the data for this map created?

The USGS GAP project maps the distribution of natural vegetation communities and potential habitat for individual terrestrial vertebrate species. These models use environmental variables (e.g., land cover, elevation, and distance to water) to predict habitat for each species. GAP modeled habitat for 1590 terrestrial vertebrate species that reside, breed, or use the habitat within the conterminous U.S. for a significant portion of their life history. Predicted habitat for 90 individual threatened and endangered species was combined to calculate richness by pixel. The 90 species included 13 amphibians, 13 birds, 44 mammals, and 20 reptiles. The mean and maximum numbers of terrestrial vertebrate species in each 30-meter pixel were calculated for each 12-digit HUC. The mean species richness value by HUC was divided by the maximum mean value within all HUCs to calculate the NIB.

## What are the limitations of these data?

EnviroAtlas uses the best data available, but there are still limitations associated with the data. These data, based on models and large national geospatial databases of predicted habitat, are estimations of reality that may overestimate actual species presence. Modeled data are intended to complement rather than replace monitoring data. Habitat models do not predict the actual occurrence of species, but rather their potential occurrence based on their known associations with

certain habitat types. Habitat is only one factor that determines the actual presence of a species. Other factors include habitat quality, predators, prey, competing species, and fine scale habitat features. Other essential species information in addition to species richness includes the types of species and their [functional groups](#), whether they are rare or common, native or non-native, tolerant or intolerant of disturbance.

## How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. Individual 30-meter pixel data may be downloaded from the [New Mexico State University Center for Applied Spatial Ecology](#).

## Where can I get more information?

A selection of resources related to terrestrial vertebrates and biodiversity is listed below. Information on the models and data used in the USGS Core Science Analytics, Synthesis & Library's [GAP](#) project is available on their website. For additional information on how the data were created, access the [metadata](#) for the data layer from the layer list drop down menu. To ask specific questions about this data layer, please contact the [EnviroAtlas Team](#).

## Acknowledgments

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## Selected Publications

1. U.S. Fish and Wildlife Service. 2020. [Endangered Species](#). Accessed April 2020.
2. U.S. Fish and Wildlife Service. 2016. [Listing a species as a threatened or endangered species: Section 4 of the Endangered Species Act](#). U.S. Fish and Wildlife Service, Endangered Species Program, Falls Church, Virginia.
3. U.S. Fish and Wildlife Service. 2015. [Federal and state endangered and threatened species expenditures](#). U.S. Fish and Wildlife Service, Endangered Species Program, Falls Church, Virginia.
4. Boykin, K.G., W.G. Kepner, D.F. Bradford, R.K. Guy, D.A. Kopp, A. Leimer, E. Samson, F. East, A. Neale, and K. Gergely. 2013. [A national approach for mapping and quantifying habitat-based biodiversity metrics across multiple spatial scales](#). *Ecological Indicators* 33:139–147.
5. Miller, B., B. Dugelby, D. Foreman, C. Martinez del Rio, R. Noss, M. Phillips, R. Reading, M. E. Soulé, J. Terborgh, and L. Wilcox. 2001. [The importance of large carnivores to healthy ecosystems](#). *Endangered Species Update* 18(5):202–210.
6. Kepner, W.G., K.G. Boykin, D.F. Bradford, A.C. Neale, A.K. Leimer, and K.J. Gergely. 2011. [Biodiversity metrics fact sheet](#), EPA/600/F-11/006, U.S. Environmental Protection Agency, Washington, D.C.